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REPORT ON A VISIT TO ICELAND AND THE POSSIBLE DEVELOPMENT OF HUMAN GENETICS IN ICELAND

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My interest in Iceland was aroused by the information, which I owe to Dr. Liverman, that many Icelanders have a keen interest in tracing thair ancestry and much genealogical work has been done which may have a genetical interest. In addition, the well known historical and geographic peculiarities of Iceland make this country a very interesting place for studies of human genetics.

I therefore decided to pay a visit to Reykjavik, which my commitments forced to keep very short. However, I have been able to make several contacts of importance. The information to be briefly summarized below was obtained especially fromseveral discussions with Prof. Niels P. Dungal, who kindly acted as host during my visit, and interviews with Dr. Klemenz Tryggvason, chief of the Census Bureau, Dr. Sigurdsson, chief medical officer of Iceland, and Mr. Einar Bjarnason, a specialist in genealogies. I am also grateful to Mr. S. Spickett who gave me some preliminary information before my visit.

AVAILABLE DATA

Current demographic work in Iceland is of a high standard. Demographic data are punched on cards, along with the individual's name. Cards are used to prepare full population rosters, ordered by address. Individuals are given numbers, and the same numbers are used for health insurance and tax purposes. Demographic records of the conventional type are available in printed pubblications from 1910, but in

addition much earlier demographic information is available, starting in a more or less regular fashion with the year 1703. It would thus be possible to trace the genealogy of a large fraction of the population starting from 1700, or more satisfactorily from 1800.

Earlier genealogies are also available but are less trustworthy and cover only a small fraction of the total population.

Consanguinity data have been made available to me by Dr. Trygvason. They are being analyzed and it would be worth testing their reliability by a small direct sampling survey.

Demographic punched cards have so far been used with conventional sorting and tabulating machines. A 1401 IBM computer will be available for use by governmental bureaus in 1964.

Medical services are completely socialized and are of good quality. There is a large number of records available in centralized bureaus. The state of health is good and there are no special sanitary problems, except perhaps that of gastric carcinoma, which is at present under analysis by an Icelandic-American team. A large nutritional study is being carried out with reference to possible nutritional causes of gastric carcinoma. There exist blood group data on some 8000 donors plus some more detailed blood groupings for paternity cases.

SOME POSSIBLE DEVELOPMENTS OF RESEARCH IN HUMAN GENETICS

Probably nowhere else in the world could "record linkage" of the kind started by H.B. Newcombe in Canada be carried out with smaller cost and better chance of collecting information of genetic, social, medical significance, than in Iceland.

In fact, it would be a relatively minor effort, at least in comparison with any other country, to centralize all the information of a genealogic, demographic, economic and medical nature already in existence, or easily available, so as to have all the information from the various sources combined together for each individual and made easily available on magnetic memory.

A general archive on magnetic disks or tapes could thus be produced which would contain for each individual, all data of demographic, medical, social etc. nature. It would then be easy to trace relatives of any degree for any individual, and so obtain all possible correlations between relatives for any recorded traits.

This work could be done in phases, as follows, though not necessarily in the sequence suggested:

1) addition of information to the present population rosters necessary to give relationship degrees between living in-individuals. Use of information already contained in the cards, plus some information e.g. from recent marriage records, would supply only partial indications on close relationships between living individuals. To cover the

whole population for close relationship (e.g. parent-offspring, sib-sib) andespecially to obtain more distant degrees of relationship, use should be made of information from earlier censuses, and other types of records, including parish books, and, when convenient, published genealogies of known reliability.

2) Demographic data, enriched with information on relationships as in 1), can be linked with socioeconomic and medical records from the tax and health insurance offices. Linkage would be a direct operation in the computer because of the identification of individuals by numbers.

3) Other sources of data already available, even if referring only to a fraction of the population, could usefully be added; e.g. information on blood groups (from donors and paternity tests); on school curricula; on nutrition etc.

4) Special surveys might be set up with specific aims in mind which would benefit enormously from the existence of all the background information, especially if this were made easily available as described above.

The advantages of carrying out such a program in Iceland arise from the availability of information not elsewhere available, from the relatively small size of the country (180,000 inhabitants), and from the absence of conspicuous immigration, making record linkage comparatively easy and complete.

Problems such as population structure, selective and assortative mating, genetics of fertility and longevity both at the biological and psychological level, would certainly

be amenable to satisfactory analysis. It is worth remembering how confuse and almost non existent is our knowledge on these issues.

It should also be noted that the major difficulty confronting genetic analysis of a great variety of traits, from physical to behavioural, is the disentanglement of "social" from "biological" inheritance, and it is only by having all the socioeconomic information that could thus be made available that the challenge offered by this problem can be met.

Because of the relatively small population size, the country does not lend itself well to research on mutation, but mutations which have arisen in the past could often be traced in all the living carriers and this might prove a good way of measuring fitnesses. If research on selection, say, of blood groups were to be made, it would not be inconceivable to type the whole population. Such data would certainly be enough for measuring selection coefficients down to fairly low values. No sampling problems and few ascertainment problems would arise on studies conducted on a population fairly homogeneous socially and economically, and well cared from the medical point of view.

It could be especially fruitful to analyze the genetics of some special conditions; psoriasis is relatively common in Iceland; alcoholism and gastric carcinoma should certainly be given much attention also from the genetic point of view. The present interest of research on gastric carcinoma is centered mostly on nutritional aspects, but records are collected in such a way that genetic ana-

lysis will be possible. In particular one might mention the hypothesis that the low rate frequency of blood groups A observed in Iceland might be the consequence of a high rate of gastric carcinoma. The higher liability of A individuals to get gastric carcinoma is known, and it could be further and more satisfactorily tested in Iceland, along with its interaction with environmental conditions.

In addition to strictly genetical problems, one should also consider the possibility of collecting in the archive the history of drugs taken by individuals, so that retrospective and prospective work on drug toxicity could be done.

Finally, it should be noted that there exist some 35,000 Icelanders or Americans of recent Icelandic origin in the U.S., which could supply a most interesting control of environmental differences, and/or migration differentials.

It is difficult, without a special investigation, to make an estimate of the cost of such scheme. To suggest the order of magnitude, a sum of $ 100,000 a year for five years might be considered. It is possible that the Icelandic Government would be prepared to share the cost of such an enterprise.